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INFORMAL REPORT

**SITE SELECTION REPORT FOR THE
NEW PRODUCTION REACTOR AT THE
IDAHO NATIONAL ENGINEERING
LABORATORY**

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Idaho Operations Office
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SUMMARY

In 1983, a site selection was performed by the Department of Energy-Idaho (DOE-ID) for the New Production Reactor (NPR) at the Idaho National Engineering Laboratory (INEL). The site selection process has recently been reviewed to determine if the primary site selected in 1983 is still considered the best site in light of the most recent site characterization data.

The results of the review are reported herein. The review showed that there is no reason to alter the previously selected primary location, Site E, for the NPR. Based on the latest geological, tectonic, hydrological, archaeological, and ecological results, Site E remains the preferred site. The review also assessed colocation impacts of the NPR facilities with other INEL facilities and showed that the NPR can safely be collocated in proximity to the Idaho Chemical Processing Plant (ICPP), Power Burst Facility (PBF), and Auxiliary Reactor Area (ARA). A simple cost analysis, contained in this report, shows that Site E will also be the lowest cost option for siting the NPR in terms of connections with the existing site facilities.

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1. INTRODUCTION

The need for a new tritium and plutonium production facility has been identified since the early 1980s. To meet this need, the DOE has proposed deployment of an NPR. As one of three DOE reservations under consideration for siting the NPR, the INEL initiated a site selection process to identify primary and alternate sites for the facility.

This report reviews the process used at the INEL to select the currently proposed site for the NPR. This will provide traceability for identifying individuals and processes involved. Key decision points are identified and dated to the extent possible. Potential adverse interactions arising from colocation with other INEL facilities are analyzed. This document also summarizes site characteristics that demonstrate suitability based on DOE and Nuclear Regulatory Commission (NRC) siting criteria.

2. SITE SELECTION CRITERIA

Early efforts focused on identifying appropriate criteria for site selection, based on NRC requirements for commercial reactors, minimum design criteria, and cost and environmental considerations. In 1982, a team was assembled for identifying siting criteria by the NPR Project Support Office at EG&G Idaho, Inc., with R. A. Cushman as team leader.¹ The following individuals were involved:

R. A. Cushman	NPR Project Support Office
R. Cutadean	Training & Development (K-T)
J. Cassidy	Facilities Management
B. E. Doane	Facilities Management
D. P. Frank	Facilities Management
A. B. Crockett	Environmental Sciences
M. Martz	Environmental Sciences
S. T. Hinshberger	Geosciences
J. Van Zee	Security
T. Sanford	Security
D. Halls	Safety
T. B. McLaughlin	Projects & Systems Engineering
M. S. Vargo	Power Reactors
J. T. Barracough	U.S. Geological Survey (USGS)

This team used Kepner-Tregoe Decision Analysis to separate criteria into "musts" and "wants." Musts were those criteria considered to be minimum requirements for site acceptability. Those sites that did not meet these requirements were to be eliminated from further consideration. Wants were those criteria that were considered desirable and were used to rank the sites. The team assigned weighting factors to each of the desirable criteria according to relative importance.² Using this system, each site would be scored on a scale of 1 to 10 relative to its ability to satisfy each criterion. Each score would be multiplied with the weighting factor, and the weighted scores for all criteria would be added for a total weighted score for each site. This would allow ranking of sites based on total weighted scores.

Implementation of the selection criteria and ranking system was preempted by DOE-ID in November 1982.³ The site selection process at the INEL was reinitiated in 1983 under the direction of J. H. Sako, Deputy Director, Reactor Operations and Programs Division, DOE-ID. A selection team was formed with the following members:

A. D. Balls	Eng. & Const. Mgmt., DOE-ID
J. T. Barraclough	USGS (retired)
T. J. Hill	NPR Project Support Office, EG&G Idaho
K. L. Hoewing	Office of Chief Counsel, DOE-ID
W. D. Jensen	Operational Safety Div., DOE-ID
J. H. Sako	NPR Project Office, DOE-ID
L. K. Seymour	NPR Project Office, DOE-ID

This team adopted, for the most part, the selection criteria developed by the Cushman team, with modifications by M. L. Griebenow of EG&G Idaho. Some additional changes were made by the selection team to reflect changes in the relative importance of some criteria. "Go/No-Go" criteria, or minimum requirements, were identified as follows:⁴

1. Five mi from capable fault.
2. Outside volcanic exclusionary zone (5 mi for vents in rift zones, 3 mi for vents outside rift zones).
3. Above probable maximum flood due to Mackay Dam failure.
4. Meet 10 CFR 100 population density limits.
5. One square mi or more in area.
6. Environmentally acceptable (would not involve unique habitat or destroy endangered species).
7. Water availability of approximately 30,050 acre-ft/yr (18,600 gpm).

The bases for these minimum requirements are given in Attachment A of this document, which was reproduced from Reference 4.

The DOE-ID team also established differentiating criteria similar to the "wants" identified by the Cushman team. These criteria were weighted by each DOE-ID team member, and team average weights were obtained for each of the criteria. The criteria and their average weights were as follows:

<u>Weights</u>	<u>Criterion</u>
6.2	1. Minimize adverse interactions with existing facilities.
8.0	2. Minimize the value of the safe shutdown earthquake (SSE) horizontal ground acceleration.
4.8	3. Minimize environmental impact on biota.
6.8	4. Maximize distance from volcanic exclusion zone.
3.5	5. Maximize groundwater transmissivity.
4.8	6. Maximize distance from public highway.
6.0	7. Maximize distance from site boundaries.
4.7	8. Minimize distance from DOE acquired land.
3.5	9. Minimize commuting distance.
5.8	10. Minimize depth of wells for water supply.
7.5	11. Minimize length of new roads.
7.0	12. Minimize length of new railroad track.
3.3	13. Minimize length of new power lines.
4.8	14. Minimize cost of new excavation.

The bases for these criteria and additional supporting information are given in Attachment B of this document, which was reproduced from Reference 4. These criteria and their assigned weights were used in the same manner proposed by the Cushman team, in that each site was scored on a scale of 1 to 10 as to how it satisfied each differentiating criterion. Team members' scores were combined to obtain a team average.

The qualitative scores were not used for the following criteria:

- 7. Distance from the site boundaries
- 8. Distance from DOE acquired land
- 10. Depth of wells for water supply
- 11. Length of new roads
- 12. Length of new railroad track.

Instead, numerical values were assigned to ranges of values for each quantifiable criterion. Average scores and numerical values were multiplied by the weighting factors for each criterion and these weighted values were summed to obtain the relative ranking for each site.

3. INITIAL SELECTION PROCESS

The site selection criteria and ranking system were implemented by the DOE-ID team in June 1983. The Go/No-Go criteria previously described were the basis for a "first cut" selection. Specifically, the following locations were mapped on a township/range/section map of the INEL:

1. DOE acquired lands (state and private land purchases) (see Figure 1).
2. Known volcanic vents (minimum 3-mi distance from older vents and 5-mi distance from more recent vents) (see Figure 2).
3. Known fault lines (minimum 5-mi distance) (see Figure 2).
4. INEL site boundaries (5-mi and 10-mi distances) (see Figure 3).
5. Estimated flood elevation from Mackay Dam failure (see Figure 4).

The minimum distances described were plotted in successive overlays that identified 33 sections as potential NPR sites. This number was later reduced by seven after volcanic features were more precisely located in the field. The remaining 26 sections were located in a roughly triangular area bounded by the 5-mi volcanic exclusion zone and the estimated flood elevation from the Mackay Dam failure (see Figure 4). These two factors were more limiting than the 5-mi distance to capable faults or the site boundary. The 10-mi distance to the site boundary, depicted in green in Figure 3, was considered too restrictive and was not used.

The 26 sections were evaluated using the differentiating criteria and ranking system previously described. Application of the differentiating criteria resulted in six distinct clusters of sections similar in ranking and location. The DOE-ID team decided to average the rankings of the sections within the clusters to reduce the number of candidate sites from 26 sections to six areas depicted as A through F in Figure 4. The six areas and their average rankings are listed in Table 1.

Idaho National Engineering Laboratory DOE Purchased Lands

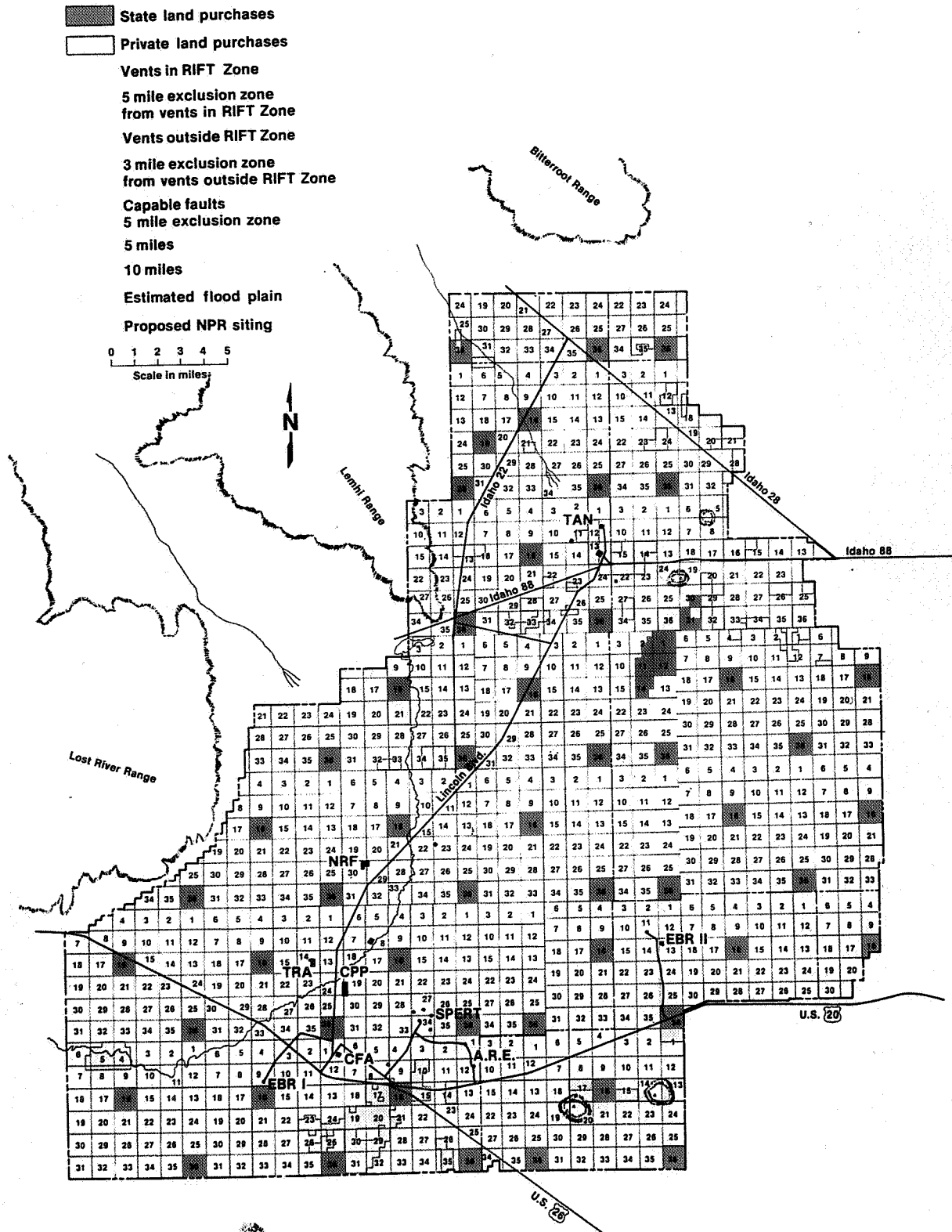


Figure 1. DOE acquired lands.

Idaho National Engineering Laboratory

DOE Purchased Lands

Exclusion Zones for Volcanic Vents and Faults

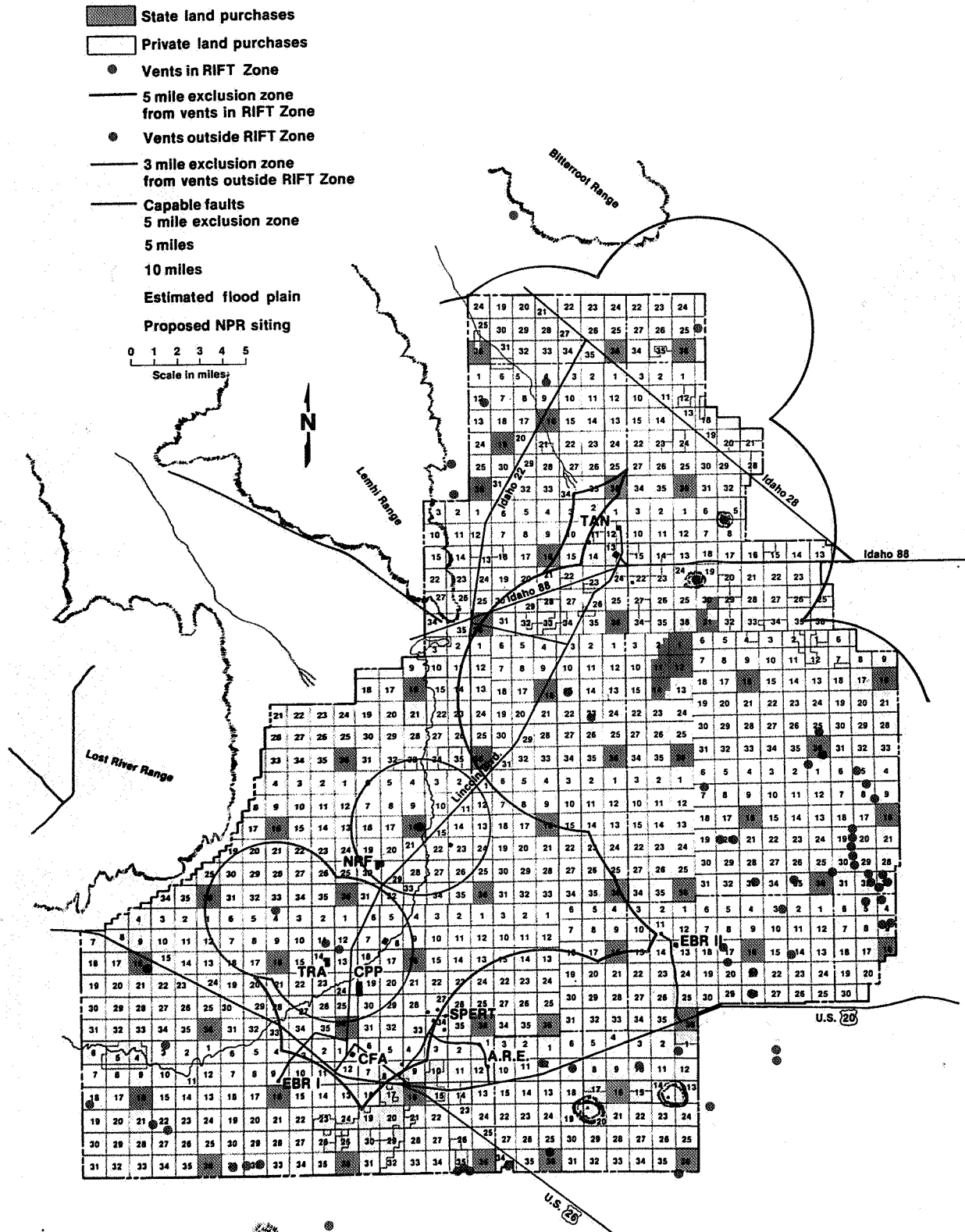


Figure 2. Exclusion zones for volcanic vents and capable faults.

Idaho National Engineering Laboratory

DOE Purchased Lands

Exclusion Zones for Volcanic
Vents and Faults

Distance to Nearest Site
Boundary

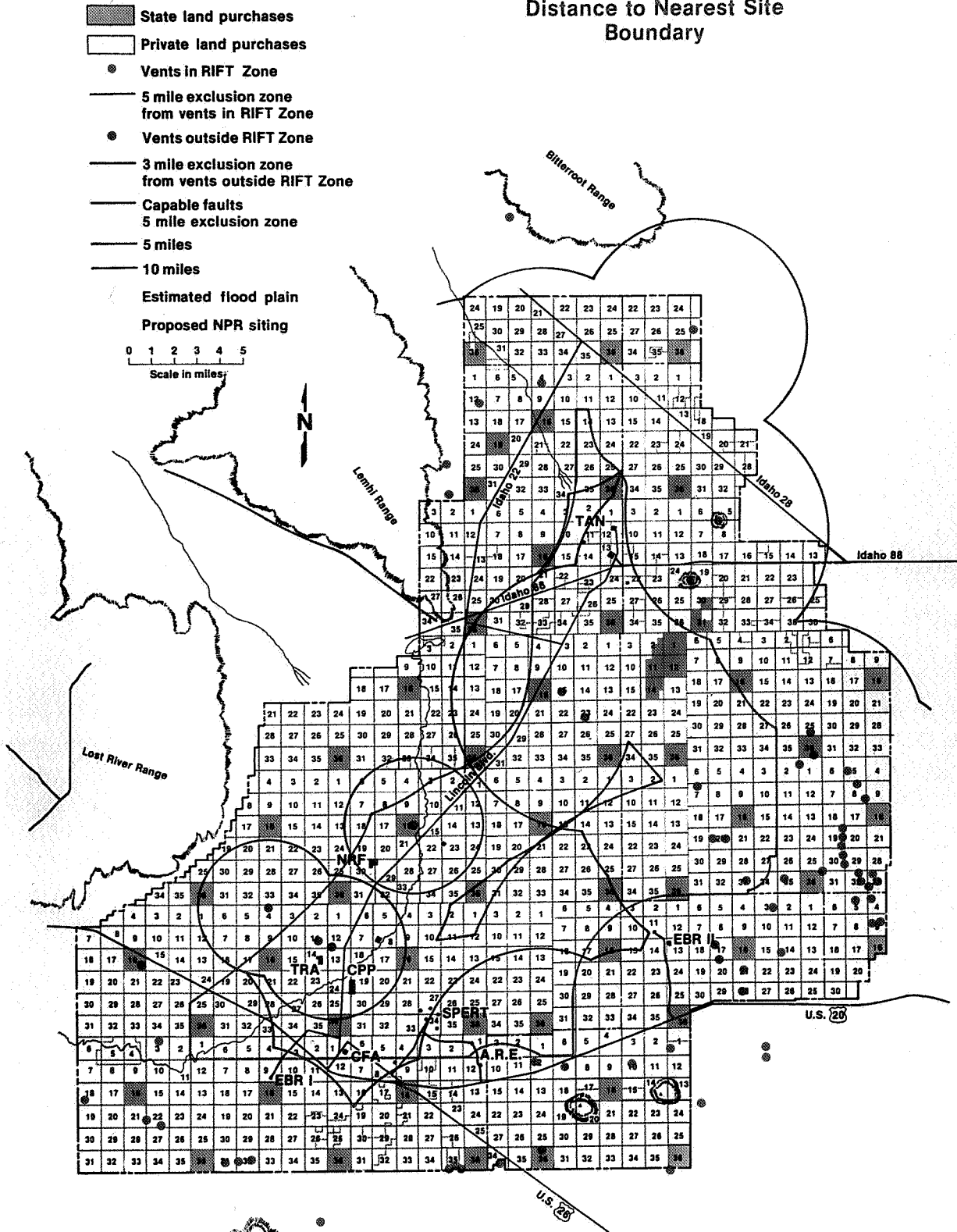


Figure 3. Minimum distances to the INEL site boundary.

Idaho National Engineering Laboratory

DOE Purchased Lands

Exclusion Zones for Volcanic Vents and Faults

Distance to Nearest Site Boundary

Estimated Flood Plain from Mackey Dam Failure Proposed NPR siting

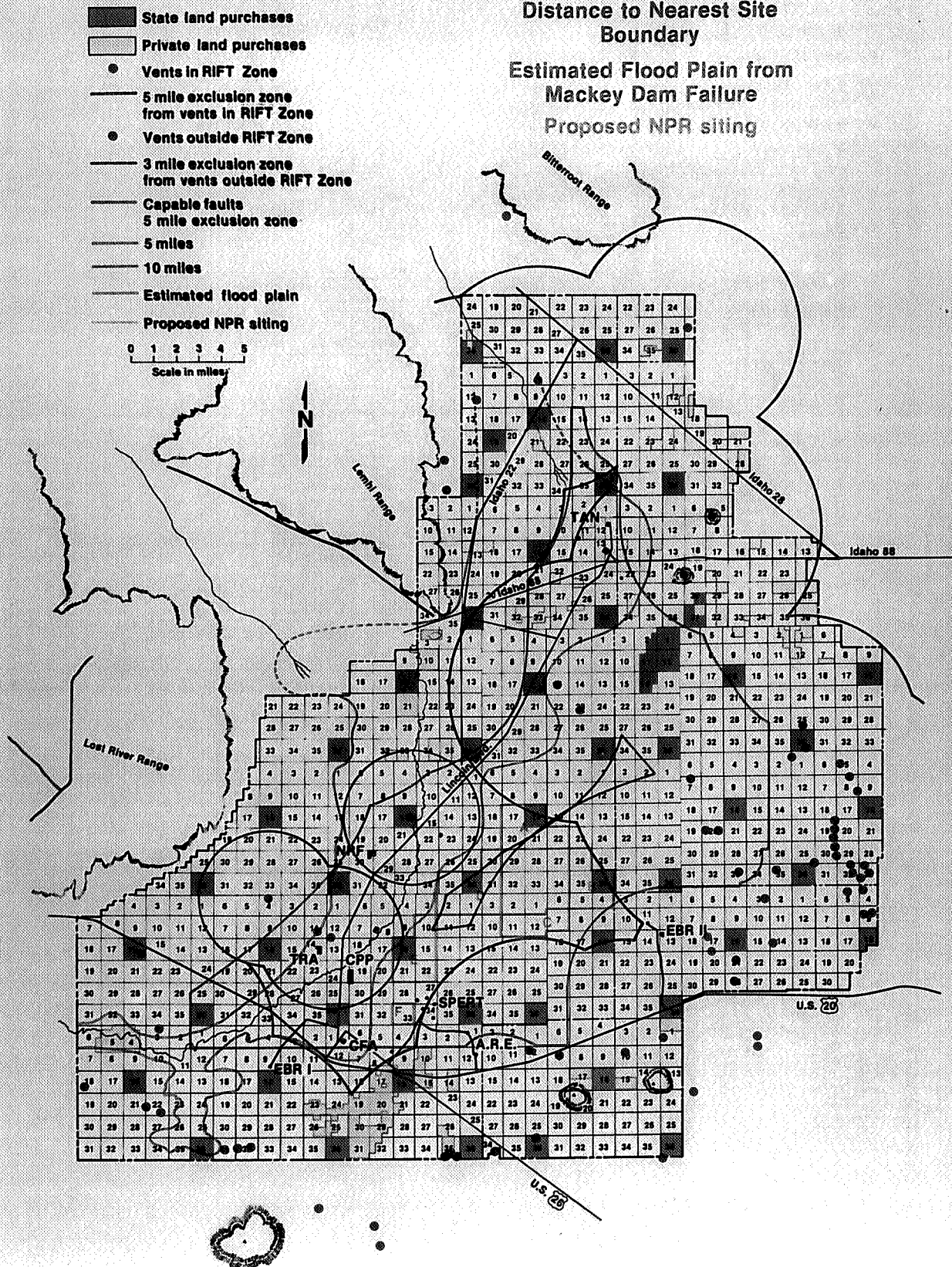


Figure 4. Criteria used for siting and initial site selection.

TABLE 1. NPR CANDIDATE AREAS AND RANKINGS IDENTIFIED BY THE DOE-ID SELECTION TEAM (JUNE-JULY 1983)

<u>Area</u>	<u>Township & Range</u>	<u>Section</u>	<u>Ranking</u>
A	4N, 31E	16,17,20,21,22	431
B	4N, 31E 3N, 32E	26,35,36 4,5	370
C	3N, 31E 3N, 32E	11,12 7	346
D	4N, 31E 4N, 30E 3N, 30E 3N, 31E 4N, 30E	30,31 35 1,2 3 36	450
E	3N, 30E	10,15,16,21,22	479
F	3N, 30E	33	426

Using the rankings given in Table 1, the selection team chose the top four areas for further evaluation in the field. General observations were made during a field trip to each area in July 1983; however, no sites were eliminated nor did any change in the ranking result. The team report recommended areas E, D, A, and F, in declining order of acceptability, as locations for siting the NPR at the INEL.

4. FINAL SELECTION

Final selection of the primary and alternate site for NPR was made by DOE-ID management. Site E was chosen as the primary location. Favorable characteristics of Site E include close proximity to the ICPP, where fuel processing for the NPR would occur. Site E is also close to established roads, the railroad, and the INEL electrical transmission loop, which would minimize construction costs for linking to those facilities. Site A was chosen as an alternate location in the event that further investigations disqualified Site E. Of the four sites recommended by the selection team, Site A was the furthest from existing facilities, which would minimize adverse interactions with those facilities. Site A remains as an alternate site, but characterization efforts are focused on the primary Site E.

5. SUMMARY OF SITE CHARACTERISTICS

The proposed NPR Site E and alternate Site A were characterized in the INEL Site Characterization Report that was prepared in 1984 and 1985 to support an anticipated Environmental Impact Statement (EIS) for NPR.⁵ Characterization efforts focused on smaller tracts (sites) located within the areas previously identified. The report included information for both the primary and alternate sites on demography, geology and seismology, hydrology, and cultural resources. The characterization data for Site E were summarized and included with other supporting information in the INEL Siting Report for the NPR, prepared for DOE's Site Evaluation Team in 1988.⁶ Information contained in these reports is summarized here to demonstrate the suitability of the proposed site with respect to the selection criteria. Site characteristics affecting design are given in Table 2. It should be noted that the proposed site is the subject of ongoing geologic, hydrologic, and pathways studies. Results of these studies and other current information will be used to update the Site Characterization Report.

Location

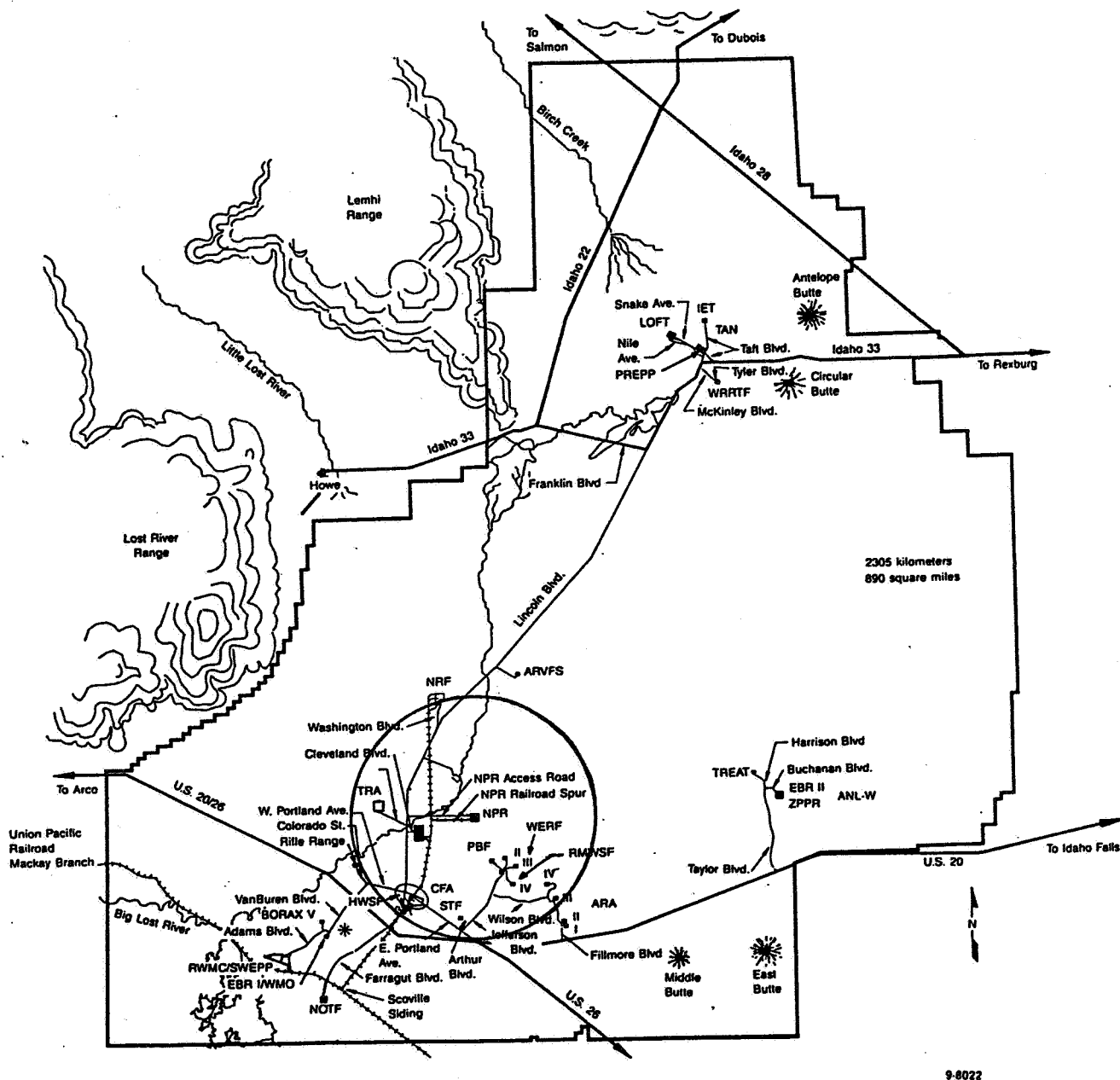
The proposed site is a 1280-acre (518-ha) area centered at approximately 43° 34' 30" N latitude, 112° 52' 10" W longitude (Universal Transverse Mercator Zone 12, 48,265,400 m N, 3,491,600 E). The proposed site is approximately 0.5 mi. (0.8 km) north and 2 mi (3.2 km) east of ICPP (see Figure 5). The site occupies portions of Sections 15, 16, 21, and 22, T3N, R30E and includes land purchased by DOE from the State of Idaho (Section 16), which would facilitate the siting of a commercial electrical generation facility nearby (see Attachment B).

Elevations on the site range from 4900 to 5000 ft (1494 to 1524 m), with an average elevation of 4950 ft (1509 m) (see Figure 6). The surface of the site consists of shallow soils with numerous basalt outcrops. Generally, the terrain slopes toward the Big Lost River, that passes approximately 1.8 mi (2.9 km) northwest of the center of the site.

TABLE 2. CHARACTERISTICS OF THE PROPOSED NPR SITE AFFECTING DESIGN

Parameters	Site Characteristics
Soils:	
Depth	0 to 4 ft of alluvium overlying basalt
Static bearing capacity (psf)	(to be determined)
Soil shear modulus (psf)	(to be determined)
Water:	
Source	self-charging Snake River Plain aquifer
Depth	475 ft
Quality	(see Table 3)
Availability	>30,050 ac-ft/yr
Climatology:	
Avg. air temp. (°F) at INEL	<u>dry bulb</u> <u>wet bulb</u> <u>dew point</u>
January	16.5 14.7 7.4
July	69.0 47.9 33.5
Annual	42.6 33.2 20.4
Extreme high	101
Extreme low	-47
Precipitation (in.)	<u>high</u> <u>low</u> <u>average</u>
Annual	14.4 4.5 9.07
Monthly	4.4 0.0
Wind speeds (mph)	<u>@ 20 ft</u> <u>@ 250 ft</u>
Average annual	7.5 12.6
Highest annual	51 67
Tornado	
Annual risk probability	7.8×10^{-5a}
Maximum wind speed (mph)	175 ^a
Tangential velocity (mph)	145 ^a
Translational velocity (mph)	30 ^a
External pressure drop	0.65 in. at 0.25 psi/s ^a
Other:	
Flooding	No special provisions are required for NPR (see text for discussion of the Probable Maximum Flood)
Seismic	
Seismic zone	Uniform Building Code Zone 2
Safe shutdown earthquake	(to be determined)
Design basis earthquake	(to be determined)

a. Design basis tornado parameters are under review; the figures presented are subject to change.



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Figure 5. Location of the proposed NPR site and 5-mi radius.

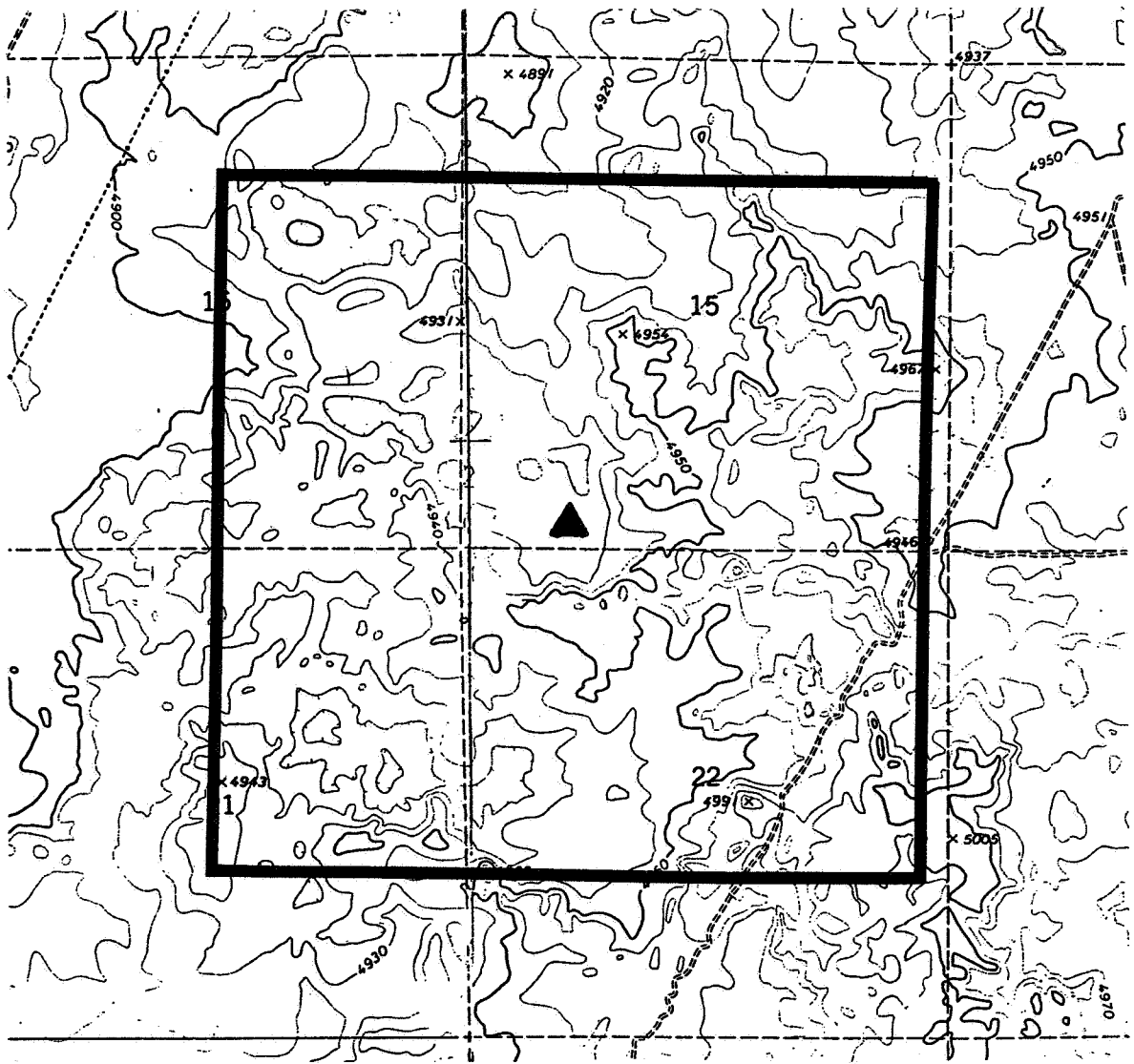


Figure 6. Elevations for proposed NPR Site E.

Capable Faults

Appendix A of 10 CFR 100 requires identification of capable faults in the vicinity of a proposed reactor site. Two capable faults nearest the site are the Arco segment of the Lost River Fault, located approximately 22 mi (35 km) west, and the Howe segment of the Lemhi Fault, located approximately 17 mi (27 km) northwest. At these distances, these faults are well beyond the 5-mi criterion given in 10 CFR 100, Appendix A for faults requiring investigation and are not expected to affect the siting of the NPR at the proposed site.

Although the design-basis earthquake (DBE) and safe shutdown earthquake (SSE) acceleration values have yet to be determined for the NPR, a range of SSE values has been determined for various sites on the INEL. Depending on location of the site, SSE acceleration values range from 0.22 to 0.35 g. These acceleration values are well within the range of SSE acceleration values for commercial reactor sites in the United States.

Geology

Geologic investigations at the INEL have also included evaluation of potential tectonic and volcanic hazards to siting the NPR. The proposed site is located on a 232,000 year old basaltic lava flow with an average recurrence interval of at least 68,000 yr; no recently active volcanic vents are located within 5 mi of the site. The site is located approximately halfway between the Arco-Big Southern Butte and Lava Ridge-Hell's Half Acre rift zones, in which future basaltic eruptions are most likely to occur (see Figure 7). Both rift zones are more than 12 mi from the site and are not expected to affect siting of the NPR.

Hydrology/Probable Maximum Flood

Hydrologic conditions of the proposed site will not adversely affect siting of the NPR. The Big Lost River, the Little Lost River, and Birch Creek are the three surface drainages that flow intermittently onto the

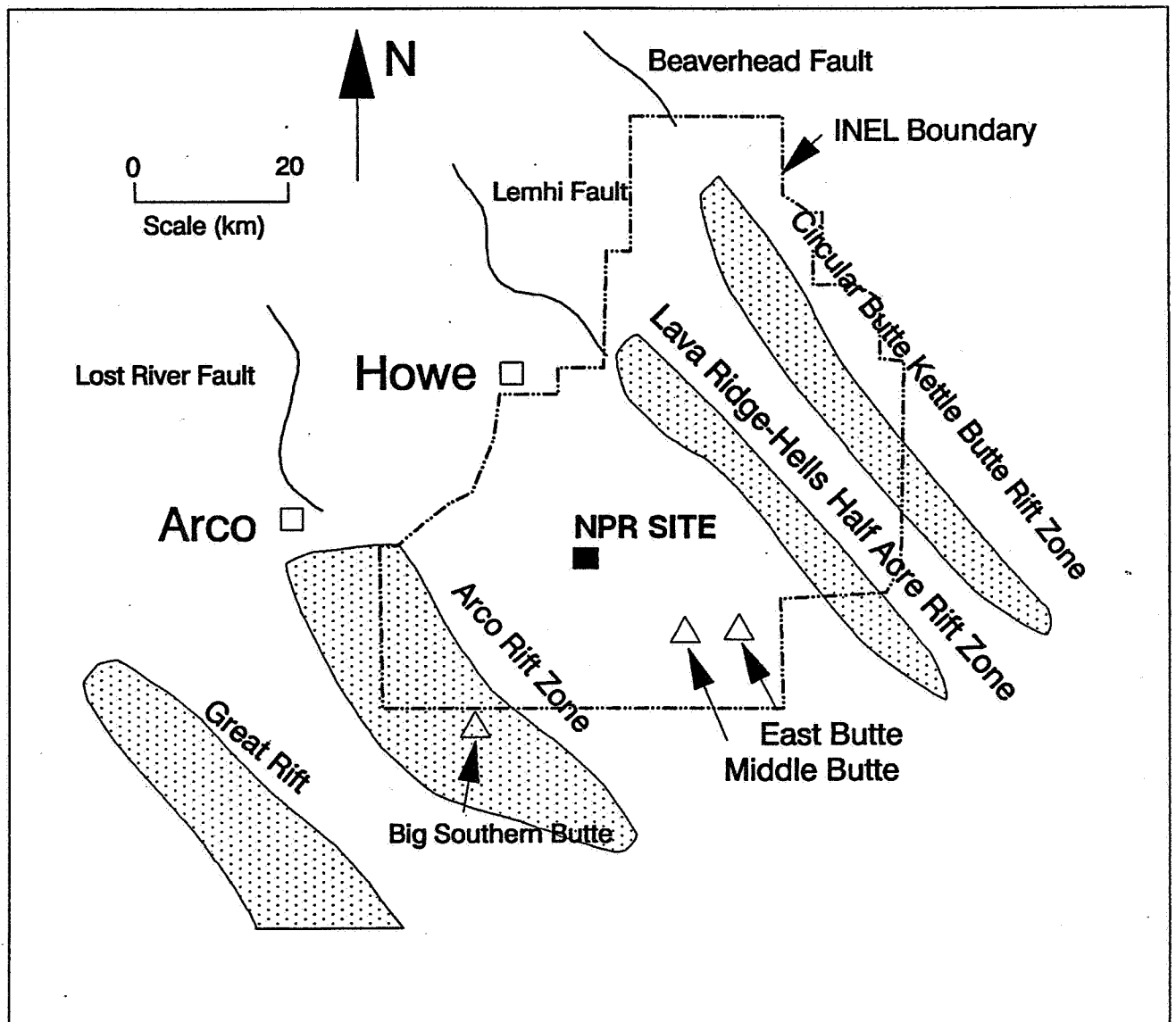


Figure 7. Location of the proposed NPR site in relation to volcanic rift zones.

INEL. No surface drainages exit the INEL. The Big Lost River, which passes nearest the proposed site, represents a minimal flood threat to the NPR site. As part of site characterization efforts, an analysis of the Probable Maximum Flood (PMF) associated with failure of the Mackay Dam on the Big Lost River was performed in 1984.⁵ This analysis, which was conducted in accordance with the requirements of 10 CFR 100, Appendix A and NRC Regulatory Guide 1.59, showed that all of the site would be above the PMF and that, on the average, the site would be more than 50 ft (15 m) above the PMF.

Water Supply

Water to be used by the NPR and its support facilities will be pumped from onsite wells in the Snake River Plain aquifer. Depth to water at the site is 475 ft (145 m). Preliminary investigations have indicated that water needs can be adequately supplied without adversely affecting the aquifer. Annual withdrawals for the NPR would constitute only a small fraction of the annual discharge from the aquifer to the Snake River. Water in the aquifer is of relatively good quality and will require only minor treatment.

Ecology

The ecology of the proposed NPR site has been characterized. Vegetation on the site is dominated by big sagebrush vegetation associations. No plant species listed as threatened or endangered by the federal government have been found on the NPR site. Fauna observed at the site include species typically found throughout the INEL. The only threatened or endangered animal species that occur on the INEL are the bald eagle and peregrine falcon, neither of which have been observed at the proposed site. No threatened or endangered mammalian species occur on the site, and no critical habitat has been identified in the vicinity of the site.

Meteorology

Meteorological conditions at the proposed site will not affect siting of the NPR. Average monthly temperatures range from 15.8°F (-9.0°C) in January to 68.2°F (20.1°C) in July. Recorded extremes at the Central Facilities Area (CFA) (4 mi southwest of the proposed site) are from -47°F (-44°C) to 101°F (38°C). Average monthly relative humidities range from 15% in August to 89% in October and December.

Annual precipitation received at the INEL averages 9.07 in. (23 cm) and has ranged from 4.5 to 14.4 in. (11.4 to 36.6 cm). Maximum observed 24-hr amounts are less than 2.0 in. (5.1 cm), and the maximum 1-hr amount is 1.19 in. (3.0 cm). Maximum precipitation is usually received in May and June with the minimum occurring in July. Snowfall generally occurs between November and April, totaling an annual average of 26.0 in. (66.0 cm). The range of annual snowfall totals is 11.3 to 40.9 in. (28.7 to 103.9 cm). The maximum 24-hr amount is 8.6 in. (21.8 cm).

Atmospheric stability at the INEL is a strong function of time of day, time of year, and cloud cover. Siting of the NPR would not be affected by atmospheric instability or severe wind loads. Annual hourly average wind speeds, measured at 20-ft and 250-ft (6-m and 76-m) heights, are 7.5 and 12.6 mph (3.4 and 5.6 m/s), respectively. The greatest hourly average wind speeds measured were 51 and 67 mph (23 and 30 m/s). Peak gusts have been measured at 78 and 87 mph (35 and 39 m/s). Only three tornadoes have been recorded at the INEL, none of which resulted in any damage. The annual tornado risk for the proposed site is 7.8×10^{-5} (see Table 2).

Air Quality

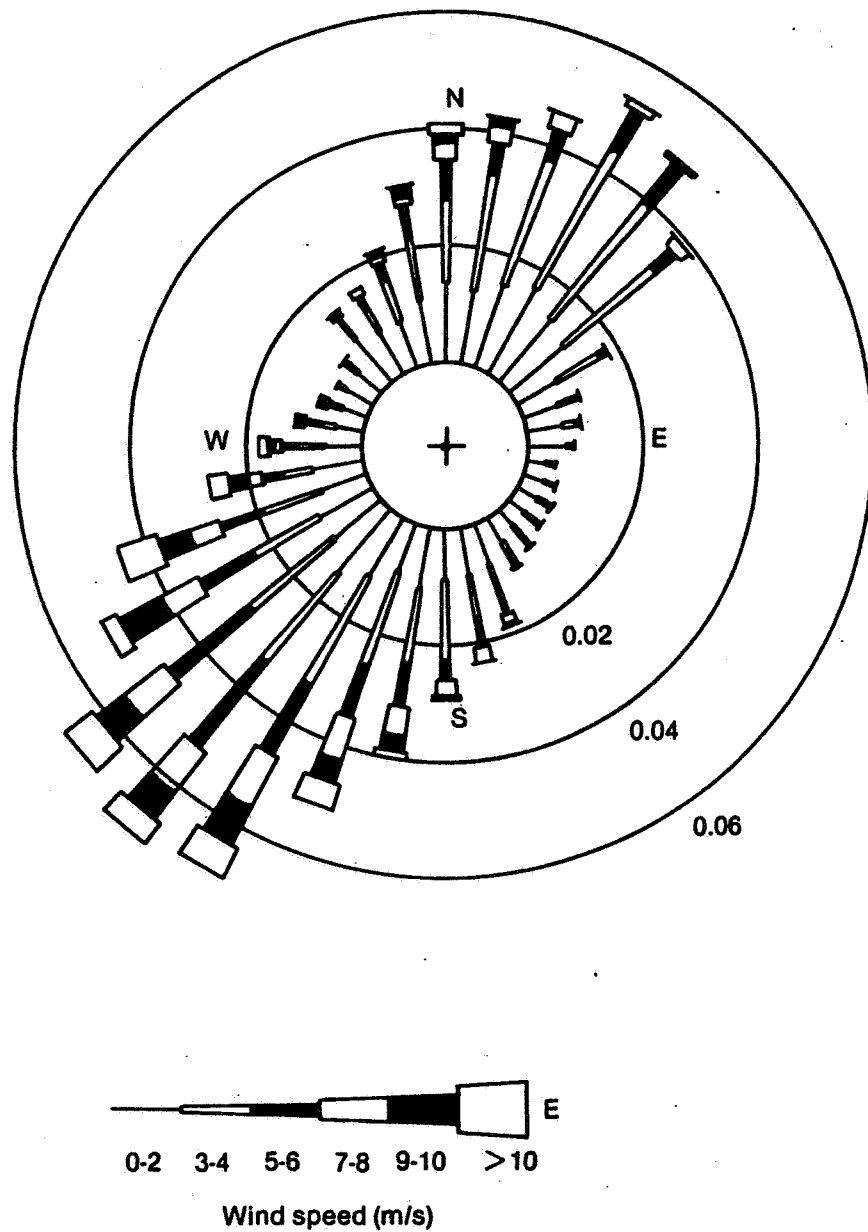
Air quality requirements will not affect siting of the NPR as atmospheric conditions at the INEL provide sufficient dispersion of contaminants. The INEL is considered an attainment area for all criteria pollutants established by the Environmental Protection Agency. Some particulate air pollution occurs at the INEL, with the major source of particulates being windblown dust.

Water vapor released from cooling towers at the INEL can produce localized fog, especially in winter. Generally, the fog is rapidly dispersed, although in especially calm conditions, plumes may extend for a few hundred meters. The NPR site is located a sufficient distance from public highways to preclude any transportation hazards from fog. Interactions between cooling tower plumes and other industrial plumes will not pose problems at the proposed site. The prevailing wind direction (see Figure 8) and the distances between the proposed site and plume generators such as the ICPP should prevent significant interaction. Further discussion of the ICPP plume and prevailing winds is found in Section 6.

Demography

The proposed site meets the population density criteria given in 10 CFR 100 and NRC Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations." Because DOE has the authority to control all activities within the boundaries of the INEL, the INEL can be considered as an "exclusion area" as defined in 10 CFR 100. The nearest INEL boundary is 9 mi (14 km) south of the proposed site, which exceeds the minimum exclusion distance of 0.4 mi given in Regulatory Guide 4.7. No resident populations are located within the INEL exclusion area. The nearest permanent residents are in Atomic City, Idaho, located approximately 10 mi (16 km) south-southeast of the proposed NPR site. Other population centers in the vicinity of the INEL are depicted in Figure 9.

Station: Grid #3 (lower)
Period: 1980-1982
Stability: SUM
Wind frequency by direction
Breakdown by wind speed category



INEL 4 4779

Figure 8. Annual wind rose for Grid 3 meteorological tower.

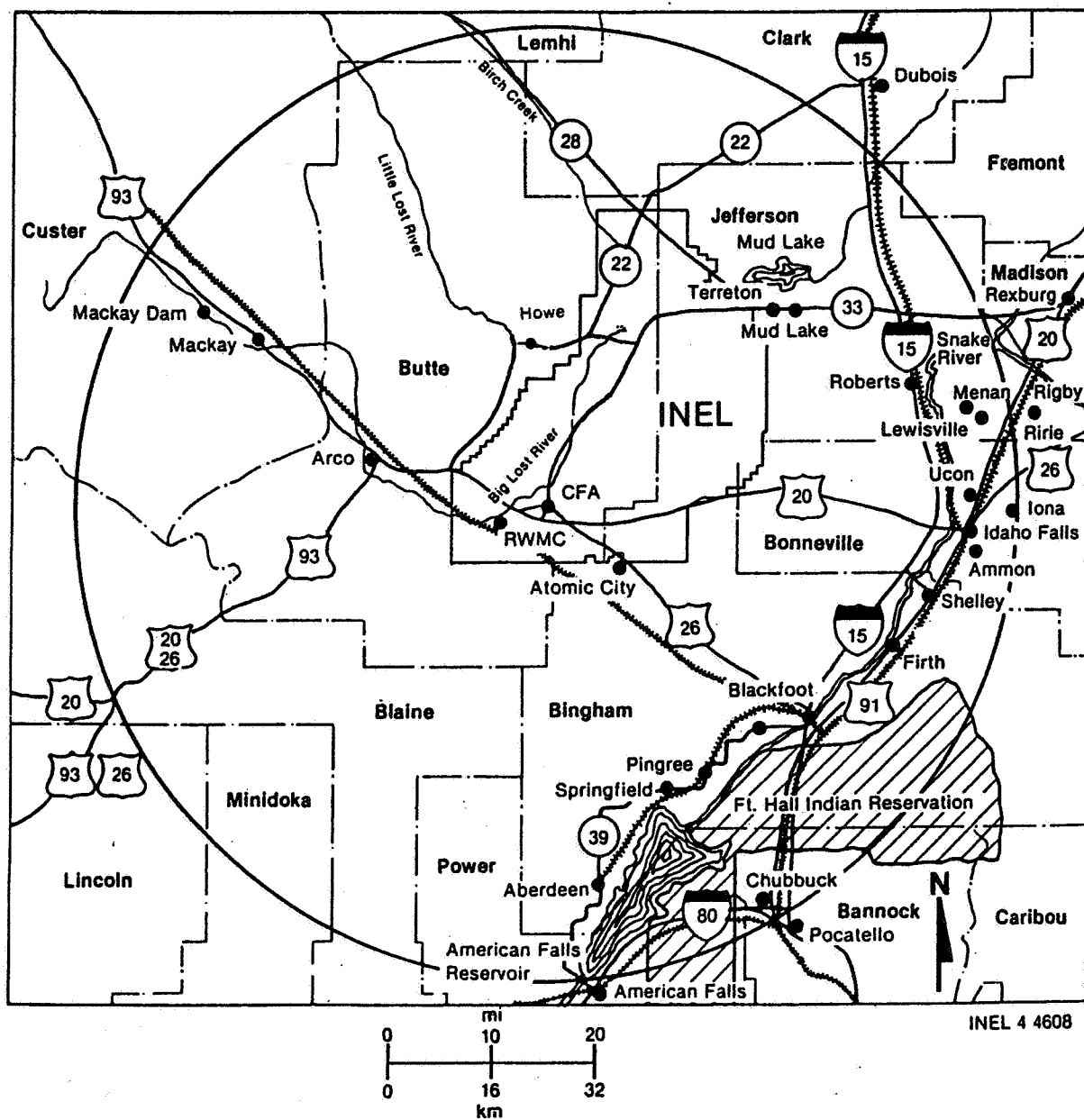


Figure 9. INEL vicinity (50-mi radius).

6. FACILITY INTERACTION ANALYSIS

The relative proximity of the NPR site to existing facilities at the INEL has raised concern regarding potential adverse interactions, that is, the effect of an accident at one facility on the operations of another. For evaluation of potential interactions, NRC Regulatory Guide 4.7 recommends analyzing impacts from accidents at facilities within 5 mi of the proposed reactor site.⁷ Facilities within 5 mi of the proposed NPR site are depicted in Figure 5. Table 3 lists direction and distances measured from the center of the proposed site to nearby facilities.

To assess potential adverse interactions, postulated accidents for the NPR MHTGR and for the PBF, ICPP, and Test Reactor Area (TRA) were analyzed. Consequences from accidents at these facilities were considered to bound those resulting from accidents at other facilities within 5 mi of the proposed site. Committed effective dose equivalents (CEDE) (DOE Order 5480.11) received by the maximum individual at each facility were calculated.⁸

For NPR, four accidents were reviewed for applicability in determining accident consequences at adjacent facilities.⁹ These most significant accidents are described in the generic design document for NPR.¹⁰ The accidents consist of (a) a depressurized conduction cooldown during which the reactor cavity cooling system (RCCS) continues to function and (b) a depressurized conduction cooldown during which the RCCS fails to operate. Each accident scenario has been analyzed using two containment leakage rates, 1% per day and 10% per day. The depressurized conduction cooldown with a functioning RCCS and a 1% leakage rate has a frequency of occurrence greater than 10^{-6} per reactor year and is considered a design-basis accident (DBA). Accidents involving the 10% leakage rate have lower frequencies of occurrence and, thus, were eliminated from further consideration in this evaluation.

The release of radioactivity from the two accident scenarios occurs at two distinct times; the initial release occurs at accident initiation and

TABLE 3. DISTANCES FROM THE PROPOSED NPR SITE TO NEARBY FACILITIES^a

<u>Facility</u>	<u>Distance</u>		<u>Direction</u>
	<u>meters</u>	<u>miles</u>	
Naval Reactors Facility	8150 ^b	5.06	NNW
Test Reactor Area	7150	4.44	W
Idaho Chemical Processing Plant	4750	2.95	WSW
Central Facilities Area	7250	4.50	SW
Security Training Facility	6900	4.29	SSW
Power Burst Facility (SPERT I)	2900	1.80	S
PBF Control	3550	2.21	S
Special Power Excursion Reactor Test II	2850	1.77	SSE
Waste Experimental Reduction Facility (SPERT III)	3400	2.11	SSE
Radioactive Mixed Waste Storage Facility (SPERT IV)	4500	2.80	SSE

a. All measurements taken from 7.5 ft USGS quadrangle maps, margin of error, 50 m. Measurements were made from the center of the NPR site as depicted in Figure 6 to the perimeter fence or nearest outlying building at each facility.

b. Five miles = 8047 meters.

the second release occurs many hours later (i.e., 50 to 80). The initial release consists of the activity in the RCCS because of normal operation of the reactor. This is designated as "circulating and plateout" activity and would be the same for each accident scenario. The second release, which occurs as a result of core heatup (i.e., thermal transient), is dependent on time-at-temperature and as such is different for the two accident scenarios. The release would be exponential and would last, if unmitigated, for a 30-day period. Because personnel at surrounding facilities would be evacuated before the thermal transient occurs, this analysis only considers the release of the circulating and plateout activity.

Table 4 lists the calculated inhalation dose equivalents at nearby facilities and the nearest site boundary (NSB) as a result of a depressurized conduction cooldown for an NPR. The results are applicable to both accident scenarios. Assumptions used to calculate the doses are documented in Reference 8.

TABLE 4. RADIOLOGICAL CONSEQUENCES AT NEARBY FACILITIES FROM A DEPRESSURIZED CONDUCTION COOLDOWN ACCIDENT AT NPR

<u>Facility</u>	<u>Distance (miles)</u>	<u>CEDE^a (rem)</u>
PBF	1.80	2.5×10^{-4}
ICPP	2.95	1.3×10^{-4}
TRA	4.45	6.7×10^{-5}
CFA	4.50	6.6×10^{-5}
NSB	10.0	2.8×10^{-5}

a. Committed effective dose equivalent.

Postulated accidents for ICPP, TRA, and PBF were analyzed for potential impacts to personnel safety and operations at NPR. A New Waste Calcining Facility (NWCF) vessel explosion was used as a representative accident at ICPP. The explosion is postulated to result from an accumulation of kerosene vapors in a calcine vessel, and releases 1.07 L of calcine solids in a "puff" to the environment. This accident has been identified as a worst-case accident at ICPP, which also bounds postulated accidents at the Special Isotope Separation Facilities.¹⁰ For this evaluation, the dose receptor was assumed to remain in the cloud for the total duration of its passage.

The representative accident at TRA involves the maximum hypothetical loss of coolant at the Advanced Test Reactor (ATR). At PBF, the representative accident involves flow blockage of a single PBF/Boron Neutron Capture Therapy (BNCT) fuel canister. For these accidents, the dose receptor is assumed to remain exposed for periods of 2 and 8 hr, respectively. Other assumptions used for the analyses of accidents at ICPP, TRA, and PBF are found in Reference 8. Table 5 lists radiological consequences at the proposed NPR site from accidents at ICPP, TRA, and PBF.

TABLE 5. RADIOLOGICAL CONSEQUENCES AT THE NPR SITE FROM POSTULATED ACCIDENTS AT NEARBY FACILITIES

<u>Facility</u>	<u>Distance (miles)</u>	<u>CEDE^a (rem)</u>
ICPP (NWCF)	2.95	6.1×10^{-2}
TRA (ATR)	4.45	1.1
PBF (BNCT)	1.80	1.6×10^{-1}

a. Committed effective dose equivalent.

Evaluation of the consequences to the safety of personnel and operations requires use of a standard dose level as an acceptance criterion. In discussing interactions, the DOE-ID team report (see Attachment A)

references "proposed" standards at 10 CFR 20. These standards, applicable to NRC-licensed facilities, limit exposure to individuals in restricted areas to 1.25 rem per quarter. DOE Order 5480.11 sets a similar standard of 5 rem annual effective dose equivalent for routine occupational exposures. No specific guidelines have been identified for allowable accident doses to workers in facilities near one in which an accident occurs. DOE-ID Order 5480.1A, Chapter XI allows a dose of up to 25 rem to persons onsite for one-time exposure to extremely unlikely events (10^{-4} to 10^{-6} per year). A dose of 10 to 25 rem is allowed for operator actions to protect personnel or property, according to DOE Order 5480.11. For this evaluation, the 5-rem standard is acceptable.

Calculated dose consequences given in Tables 4 and 5 are all below the 5-rem criterion. Based on these results, the analyzed DBA for NPR at the proposed site would not present a significant hazard to personnel or safe operations at nearby facilities. Conversely, postulated accidents at ICPP, TRA, and PBF would not present unacceptable hazards to the safety of personnel or operations at the proposed NPR site. These results indicate that the NPR can be safely colocated with existing facilities. From a safety perspective, the proposed site is suitable for siting the NPR.

In summary, the results of colocation accident analyses indicate that siting the NPR at the proposed site would not impact safe operations at the NPR or nearby facilities. Calculated radiological consequences from accidents are not significant enough to require use of an alternative site.

7. EVALUATION OF ALTERNATIVE SITES

The suitability of the proposed site can be seen by comparison with alternative sites. Potential alternative sites include Sites A and D, as identified by the DOE-ID team, which lie further northeast of the proposed site. Although areas northeast of the proposed site would be further from ICPP, they would be more likely to be affected by a contaminant plume from ICPP. Figure 8 depicts a wind rose for the Grid 3 Meteorological Tower located approximately 1 mi north of ICPP. The wind rose graphically depicts wind frequency in percent of occurrence for 36 direction sectors and six wind speed classes. Southwesterly winds, which would carry a plume northeast from ICPP, have the highest annual average frequency. Because it lies in a more easterly direction from ICPP, the proposed site is less likely to be affected by a contaminant plume originating from ICPP.

In addition to lying within the ICPP plume, alternative sites to the northeast may also be affected by the Naval Reactors Facility (NRF). Siting NPR within 5 mi of NRF would require analysis of potential interactions for at least three reactors and their support facilities, which may be difficult to perform given the classified nature of NRF operations. Potential interactions between the proposed site and NRF are not considered here as the separation distance is greater than 5 mi.

Sites further northeast of the proposed site would also lie closer to the Lava Ridge-Hell's Half Acre rift zone. As shown in Figure 7, the currently proposed site lies roughly equidistant between the that rift zone and the Arco rift zone, minimizing the risk from either.

Ecological considerations also may limit alternatives to the proposed site. An ecological characterization of primary Site E and alternate Site A indicated that Site A includes important wintering and nesting habitat for some species, and the impacts for locating the NPR at Site A would have to be evaluated.⁵

A review of the preliminary archeological survey of Site A indicated that areas northeast of Site E would have cultural resource site densities at least as high as those found during a detailed survey of Site E. ¹¹ Site A and other alternative locations to the northeast also are further from existing electrical transmission lines and roads. Construction of longer rights-of-way to connect NPR with these facilities would impact more sites from a cultural resource perspective. Although these sites may be small in size and content, collectively they have scientific value and would require further investigation.

Given the limitations to alternative sites northeast of the proposed site, alternative areas to the east were considered. As depicted in Figure 4, the DOE-ID team identified two areas, B and C, which lie east of Site E. Although these areas are located farther from the existing facilities discussed, they are within 5 mi of the Transient Reactor Experiment Test Facility and Experimental Breeder Reactor II. Siting of the NPR at either Site B or C would require analysis of interactions with these facilities, which would probably indicate that colocation would be acceptable. However, Sites B and C are also closer to the Lava Ridge-Hell's Half Acre rift zone, which increases risk to NPR facilities.

The costs for moving the NPR site to the proposed alternatives were assessed. The costs are significant constraints in consideration of the alternative sites. An alternative site further northeast or east of the proposed site would require longer access roads, railroad spurs, and electrical transmission lines. These additional costs were estimated for Sites A, D, and E using cost figures given in the DOE-ID team report.⁴ Distances were measured from the centers of these sites to the existing railroad spur, the INEL electrical transmission loop, and Lincoln Boulevard. These distances are summarized below.

<u>Site</u>	<u>To rail spur</u>	<u>To power lines</u>	<u>To Lincoln Boulevard</u>
A	8.8 mi	6.6 mi	5.0 mi
D	5.4	6.2	5.4
E	2.6	3.5	3.5

The distances listed were used to calculate costs for connection with existing facilities.

Site A

Railroad:	8.8 mi x \$317K/mi = \$2,790K
Power lines:	6.6 mi x \$ 80K/mi = \$ 528K
Access roads:	5.0 mi x \$500K/mi = <u>\$2,500K</u>
	\$5,818K

Site D

Railroad:	5.4 mi x \$317K/mi = \$1,711K
Power lines:	6.2 mi x \$ 80K/mi = \$ 496K
Access roads:	5.4 mi x \$500K/mi = <u>\$2,700K</u>
	\$4,907K

Site E

Railroad:	2.6 mi x \$317K/mi = \$ 824K
Power lines:	3.5 mi x \$ 80K/mi = \$ 280K
Access roads:	3.5 mi x \$500K/mi = <u>\$1,750K</u>
	\$2,854K

The cost estimates given are underestimated as they were calculated using unit costs for road and railroad construction on level terrain. The DOE-ID team report assumed higher unit costs for construction involving cut and fill over rough terrain, which may be more typical for areas with lava flows. Furthermore, the estimates are based on 1983 dollars. Using a conservative inflation adjustment factor of 1.03 per yr and assuming the plant would be constructed in 1993, the total cost estimates would be about \$8 million for Site A, \$7 million for Site D, and \$4 million for Site E. Based on these figures, it is clear that using Site A or D versus Site E would result in significant additional costs. Additional costs would be associated with transportation of personnel, feed materials, and wastes over longer distances, and over a 40-yr time period.

Consideration of an alternative site also involves additional costs for site characterization. Although preliminary characterization of Site A was done in 1984 and 1985, much additional work would be required to support an EIS.⁵ Selection of a "new" site, such as Site D, would require reinitiation of the site characterization process, which would involve significant costs. Perhaps the most significant costs would be from delays in schedules to allow additional site characterization. It is estimated that 1 to 2 yr would be required to environmentally characterize an alternative site. Current efforts to provide supporting information for an NPR EIS are focused on the proposed Site E by Fall 1991.

8. CONCLUSIONS

A review of the selection process indicates that appropriate factors were considered, including applicable NRC guidance and cost and environmental concerns. The sequence and timing of events are logical and traceable. The selected site meets the selection criteria and has no unique characteristics that would preclude siting of the NPR. A review of colocation issues indicates that accidents at either NPR or nearby facilities would not pose unacceptable hazards to other facilities personnel or operations. Moreover, relocation of NPR to avoid adverse interactions may not be desirable because of other limiting factors. Location of the NPR at the proposed site would not pose significant safety problems and would minimize both environmental impacts and construction costs.

9. REFERENCES

1. R. A. Cushman, letter to distribution, RAC-7-82, "Criteria for Selecting Site for NPR on INEL," October 7, 1982.
2. R. A. Cushman, letter to R. L. Benedetti, RAC-10-82, "Proposed Criteria for Selecting the Site for the NPR at INEL," November 10, 1982.
3. M. L. Griebenow, memorandum to A. L. Bowman, MLG-2-83, "NPR Siting Criteria," May 13, 1983.
4. J. H. Sako, memorandum to R. E. Tiller, "Submittal of NPR Location Selection Team," July, 1983.
5. EG&G Idaho, Inc., INEL Site Characterization Report, EGG-NPR-6688, September 1984 (Revised January 1985).
6. EG&G Idaho, Inc. and Westinghouse Idaho Nuclear Co., INEL Siting Report for the NPR, March 1988.
7. U.S. Nuclear Regulatory Commission, Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations," 1975.
8. H. K. Peterson, letter to K. S. Moor, HKP-24-89, "Radiological Consequence Analyses for the NPR/MHTGR Site Safety Issues Review (SSIR)," July 26, 1989.
9. EG&G Idaho, Inc., NPR-MHTGR Generic Reactor Plant Description and Source Terms, Vol. 1, EGG-NPR-8522, Final Draft, June 30, 1989.
10. Westinghouse Idaho Nuclear Co., Site Safety Issues Review for the Special Isotope Separation (SIS) Facilities, WIN-SIS-272, April 7, 1989.
11. C. F. Marler, personal communication, EG&G Idaho, Inc., May 18, 1989.

ATTACHMENT A

ATTACHMENT A

"GO/NO-GO" CRITERIA FOR NPR LOCATION ON THE INEL

Criterion

Basis

1. 5 Miles from Capable Fault

10 CFR 100, Appendix A, Section IVb requires extensive evaluation of capable faults greater than 1000 feet long, any part of which is within five miles of the site. Reg. Guide 4.7 states, "Sites that include capable faults, as defined in Appendix A to 10 CFR 100, are not suitable for nuclear power stations. The state of the art has not progressed to the point at which it is possible to design a nuclear power station for surface or near surface displacement with a sufficiently high level of confidence to ensure that the integrity of the safety-related features of the plant will remain intact."

2. Outside Volcanic

10 CFR 100 does not address investigation of volcanic phenomena required for sites located in areas of volcanic activity. It states that investigations of volcanic aspects of such sites will be determined on a case-by-case basis.

To date, no commercially licenced nuclear facility has been built on or near geologically recent basalt flows. The Southwestern half of the INEL is characterized by geologically recent lava flows - the most recent (Cerro Grande) about 10,000 years ago. Northeast of the Lava Ridge - Hell's Half Acre, the flows have been inactive for the past 4100 ± 200 ¹⁴ years. (Kuntz, M.A., Dalrymple, G.B., 1979, "Geology, Geochronology, and Potential Volcanic Hazards in the Lava Ridge - Hell's Half Acre, Eastern Snake River Plan, Idaho," U.S. Geol. Survey, Open-file report 79-1957.

3. Above Max. Mackay Dam Failure Flood Elevation 5

10 CFR 100, Appendix A, VIc requires evaluation of seismically induced floods from either locally or distant generated seismic activity. Site suitability study requirements are further amplified in Reg. Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

Attachment A (continued)

Criterion

Basis

- The maximum water height, resulting from Mackay Dam failure, is 1550.3m, above the National Geodetic Vertical Datum of 1929, at the INEL diversion 74 dm downstream from the dam (IDO-22058, "Probable Hydrologic Effects of Hypothetical Failure of the Mackay Dam on the Big Lost River Valley from Mackay, Idaho to the Idaho National Engineering Laboratory," Sept. 1979, USGS.)
- Lower siting elevations can be allowed at distances greater than 74 km from the dam (below the INEL diversion) if more sophisticated analyses are completed, including additional river bed survey input and two dimensional flow and storage effects.
4. Meet 10 CFR 100 Population Density Limits 10 CFR 100
5. One Square Mile or More Area Engineering judgement relative to production, fuel fabrication and tritium facility size and spacing requirements.
6. Environmentally Acceptable; No Unique Habitat; Doesn't Destroy Endangered Species National Environmental Policy Act, Fed. Reg./ Vol. 45/No. 62. Endangered Species Act of 1973, as amended and implemented by 50 CFR 17, Reg. Guide 4.7.
7. ~30,050 Acre ft/yr (~18,600 gpm) Direct NSSS cooling at a 70% operating factor and 100% bypass:
- Water Availability HTGR (3360 MW(t) - 25,000 acre ft/year
LWR (4000 MW(t) - 27,760 acre ft/year
- Fuel and Target fabrication and processing requirements are to be determined. About 500 acre ft/year (310 gpm) required for internal consumption (primarily makeup water).

ATTACHMENT B

ATTACHMENT B

DIFFERENTIATING CRITERIA FOR NPR LOCATION ON THE INEL

<u>Criterion</u>	<u>Comments</u>	<u>Assigned Weights</u>
1. Minimize Adverse Interaction(s) with Existing Facilities	Concerns in maximizing on-line time of a NPR. There are proposed EPA standards for Radionuclides (10 CFR 100) release and exposure limits. Reg. Guide 4.7 "Accident Coupling" may also impact facilities "too close" to each other. These items and their impacts need to be reviewed indepth before final site selection.	6.2
2. Minimize the Value of the SSE Horizontal Ground Acceleration	Available information indicated that except for the TAN area, the acceleration, in terms of "g" level ranged from .22 to .24. Since other factors essentially eliminated locating in the TAN area, all the candidate sites were rated at 9 or 10. This criterion did not contribute to a differentiation between the possible locations.	8.0
3. Minimize Environmental Impact on Biota	There should be a difference noted between an adverse impact and a beneficial impact. For instance, wildlife may be benefitted by the shelter provided by facilities and possibility of food and shelter (grass, trees, water, etc.) not available otherwise. Removing noxious weeds could also be a positive environmental impact, as compared to an adverse impact of removing flowers or grass.	4.8
4. Maximize distance from Volcanic Exclusion Zone	The selection team agreed to use a minimum distance of three miles from "older" volcanic vents and five miles from "more recent" volcanic vents. This criterion was used to make a "first cut" of many possible locations. A higher numerical value was given for sites exceeding these minima, for purposes of differentiating between sites.	6.8

Attachment B (continued)

<u>Criterion</u>	<u>Comments</u>	<u>Assigned Weights</u>
5. Maximum Ground Water Transmissivity	The ability of a site to supply 30,050 acre ft/year is a requirement; a high value of ground water transmissivity is desired for steadiness of flow and to minimize water table drawdown to minimize pumping lift costs.	3.5
6. Maximize Distance from Public Highway	Considered to improve security. Team agreed that beyond two miles there was no further gain.	4.8
7. Maximize Distance from Site Boundaries	Team agreed to minimum of five miles to make a "first cut" of the many possible locations. A distance of 10 miles was also considered, in order to minimize the impacts associated with evacuations from nearby towns/farms. The other factors severely limited the selection of potential sites at the 10 miles distance.	6.0
8. Minimize Distance from DOE Acquired Land	<p>The team was advised (by OCC representative) that DOE was authorized to lease DOE acquired lands to "private companies" as opposed to withdrawn land on the INEL. Locating the NPR as close possible to acquired lands would minimize overall construction costs to the utility(ies).</p> <p>Minimizing these costs should directly affect the price the utility(ies) would be willing to pay for steam from the NPR, i.e., lower overall construction costs should allow the utilities to pay more for steam.</p>	4.7
9. Minimize Commuting Distance	Considered to be a small factor in attracting "quality " staff to operate; minimizing commuting distance minimizes the transportation costs to the government over the total life cycle of the facilities.	3.5

Attachment B (continued)

<u>Criterion</u>	<u>Comments</u>	<u>Assigned Weights</u>
10. Minimize Depth of Wells for Water Supply	Has a direct impact on life cycle operating costs. Figures available to the team showed a cost of \$0.123/ft of depth-acre ft to supply needed water	5.8
11. Minimize Length of New Roads	Road construction estimated at \$500K/mile for 32 ft wide roads built over flat, even grade; \$760K/mile built over rocky-cut and fill.	7.5
12. Minimize Length of New Track	Railroad construction estimated at \$317K/mile over flat-even grade; \$400K/mile for rocky-cut and fill.	7.0
13. Minimize Length of New Power Lines	Estimated at \$80K/mile to run new line; for safety reasons, two redundant lines would be required; team assumed that power could be exported using the same rights-of-way and possible the same poles/towers.	3.3
14. Minimize Cost of Excavation	Estimated at \$2/yd for earth and gravel; \$35K/yd for basalt with uncontrolled blasting.	4.8

